



Three-dimensional basin analysis of the Heidelberg Basin, Upper Rhine Graben

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The Heidelberg Basin (HB) is a part of the Upper Rhine Graben that has undergone very strong subsidence throughout its existence. We present the first results of three-dimensional structural modelling of the basin, based on interpretation of reflection seismics, and decompaction based on our own porosity data measured from core material. Firstly, we mapped six horizons from all available industrial (ca. 100 km) and our own reflection seismic sections (ca. 15 km), which lie within a 8 km radius around the Heidelberg Uni-Nord 1/2 boreholes. We interpret these horizons as Base Quaternary, Internal and Base Pliocene, Base Upper Miocene, Internal and Base Mid Miocene Hydrobien beds.

This data was used to construct a three-dimensional geometrical model of the Heidelberg Basin using GoCAD. The model shows that the HB has a N–S and E–W areal extent of only 10×6 km, directly abutting the eastern boundary fault of the Upper Rhine Graben. The strongest syn-sedimentary tectonic subsidence occurred during the Upper Miocene, Upper Pliocene, and Quaternary. Furthermore, the sedimentary depocentre shifted 2 km northwards over time to the present location, directly below the city of Heidelberg.

Using 300 core samples, we determined the porosity of the Quaternary sediments from their dry, saturated and submerged masses. We constructed an exponential porosity/depth relationship for these rocks, which was then attributed to the model. We determined that Quaternary sediments have porosities of over 60% at the surface, but towards the base of the Quaternary, porosity is less than 35%. This strong decrease means, for instance, that 740 m of sediments were compacted to produce the present ca. 500 m thickness of Quaternary strata. This data were then used to decompact and backstrip the whole 3D model using the software 3Dmove. The results show that the basin was under continuous subsidence, with a slightly less subsidence rate during the Upper Miocene, but with higher rates in the Pliocene to present-day, thus the basin subsidence in general is accelerating. At the depocentre of the basin, the slowest rate rate of subsidence was 0.1 mm a^{-1} , while during the Quaternary this increased to 0.2 mm a^{-1} . In comparison, values for the Rhine Graben outside of the HB are ca. 30–50% less.